

Message Text

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INFO OCT-01 NEA-10 ADP-00 SS-15 SCI-06 EPA-04 NSC-10 HEW-08

DOT-00 INT-08 HUD-02 DOD-00 CEQ-02 EB-11 IO-13

CIAE-00 PM-07 INR-10 L-03 NSAE-00 PA-03 RSC-01 PRS-01

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INFO USMISSION NATO

AMEMBASSY ANKARA

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AMEMBASSY OSLO

AMEMBASSY OTTAWA

AMEMBASSY PARIS

AMEMBASSY REYKJAVIK

AMEMBASSY THE HAGUE

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E.O. 11652: N/A

TAGS: NATO, SENV

SUBJ: CCMS: GEOTHERMAL ENERGY PROJECT

1. /SUMMARY/: US CCMS GEOTHERMAL TEAM MET WITH OFFICIALS
ENTE NAZIONALE PER L'ENERGIA ELETTRICA (ENEL) AT ENEL
HEADQUARTERS IN ROME JULY 10 AFTER VISITING LARDERELLO SITE
JULY 9. ENEL IS STATE CORPORATION PROVIDING ELECTRICITY TO
ALL OF ITALY. WHILE ORGANIZATIONALLY UNDER MINISTRY OF INDU-
STRY, ENEL OPERATES GENERALLY INDEPENDENTLY IN ENERGY FIELD
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AND HAS EXCLUSIVE AUTHORITY IN ITALY FOR GEOTHERMAL ENERGY

EXPLOITATION. ENEL WORKS CLOSELY WITH NATIONAL RESEARCH COUNCIL (CNR) WITH RESPECT TO GEOTHERMAL EXPLORATION. GEOTHERMAL POWERED ELECTRICITY GENERATION (ROUGHLY 415 MEGAWATTS) ACCOUNTS FOR 3 PERCENT OF THE ITALIAN TOTAL. ENEL ANNUAL GEOTHERMAL RESEARCH BUDGET PRESENTLY EQUALS EQUIVALENT OF \$1 MILLION/YEAR. ANNUAL PRODUCTION DRILLING BUDGET IS APPROXIMATELY \$4 MILLION. ENEL AND CNR EMPLOY A TOTAL OF ABOUT 60 PROFESSIONALS IN GEOTHERMAL AREA. FURTHER, ENEL, IN COOPERATION WITH CNR'S INTERNATIONAL INSTITUTE OF GEOTHERMAL RESEARCH AT PISA, PRESENTLY ENGAGES IN VARIOUS INTERNATIONAL PROJECTS (INCLUDING THOSE ORGANIZED UNDER THE AUSPICES OF THE UN). IN RESPONSE TO GENERAL PRESENTATION PRESIDENT OF ENEL, ARNOLDO M. ANGELINI, STATED THAT ENEL WOULD BE "VERY INTERESTED" IN COOPERATION IN GEOTHERMAL AREA. ANGELINI PARTICULARLY STRESSED NEED TO COOPERATE WITH RESPECT TO ENVIRONMENTAL PROBLEMS. THE PROBLEM OF SUPPLY VS. DEMAND HAS BECOME INCREASINGLY IMPORTANT WITH ENVIRONMENTAL CONCERNS ADDING TO THE PROBLEM. POSSIBLY BY THIS WINTER AND FOR SURE BY NEXT THERE WILL BE SOME RATIONING OF ENERGY.

GEOTHERMAL PROJECT AREAS OF INTEREST TO ENEL INCLUDE THE DEVELOPMENT OF SEISMIC EXPLORATION TECHNIQUES DEVELOPMENT OF REINJECTION TECHNOLOGY, GEOTHERMAL RESERVOIR PHYSICS AND MODELLING, GENERAL TECHNIQUES OF ENVIRONMENTAL HAZARD MONITORING WHICH WOULD SPECIFICALLY INCLUDE THE TAGGING AND TRACING OF GEOTHERMAL WATERS, AND FINALLY, ENERGY RECOVERY FROM HOT WATER AS LOW AS 100/O C.

IT WAS AGREED THAT THE US WOULD CIRCULATE PROPOSALS RESULTING FROM THEIR DISCUSSIONS WITH THE VARIOUS NATO COUNTRIES CONCERNED WITH A VIEW TO ORGANIZING A MEETING TO LAUNCH THE PROJECT.

PROFESSOR ENGINEER TEO LEARDINI (DIRECTOR OF ENEL CENTER FOR STUDIES AND RESEARCH) UNDER PRESIDENT ANGELINI WILL BE ITALIAN CONTACT POINT FOR GEOTHERMAL PROJECT. /END SUMMARY/

2. AS OF 1971, THE TOTAL ELECTRICAL GENERATING CAPACITY IN ITALY FROM ALL FORMS OF ENERGY WAS 14,500 MEGAWATTS WITH 31 UNCLASSIFIED

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PERCENT FROM HYDRO, 62.3 PERCENT FROM FOSSIL FUELS, 3.7 PERCENT FROM NUCLEAR, AND 3.0 PERCENT FROM GEOTHERMAL. THE ENTE NAZIONALE PER L'ENERGIA ELETTRICA (ENEL) IS A STATE CORPORATION PROVIDING ELECTRICITY TO ALL OF ITALY.

3. MR. ARNOLDO M. ANGELINI, PRESIDENT OF THE CORPORATION, ATTENDED PART OF THE DISCUSSIONS IN ROME WHICH WERE LEAD BY PROFESSOR ENGINEER TEO LEARDINI WHO IS IN CHARGE OF ALL

ENERGY RESEARCH WITHIN ENEL. THIS INCLUDES RESEARCH AND EXPLORATION FOR GEOTHERMAL ENERGY. THE GEOTHERMAL RESEARCH AND EXPLORATION UNIT, THE CENTRO RICERCA GEOTERMICA, IS LOCATED IN PISA AND IS DIRECTED BY DR. PIETRO CERON. THE DEVELOPMENT AND OPERATIONS UNIT IS HEADED BY MR. C. BRAZZIOLI AND IS LOCATED IN ROME.

4. THE SECOND MAJOR CONCENTRATION OF PEOPLE DOING GEOTHERMAL ENERGY RESEARCH IN ITALY IS AT THE UNIVERSITY OF PISA. THE INTERNATIONAL INSTITUTE FOR GEOTHERMAL RESEARCH IS DIRECTED BY PROFESSOR L. TONGIORGI. THE INSTITUTE IS FUNDED BY THE CONSIGLIO NAZIONALE DELLE RICERCHE (NATIONAL COUNCIL OF RESEARCH (NCR)) AND IS ABOUT 5 YEARS OLD. THE INSTITUTE HAS A FORMAL AGREEMENT OF COLLABORATION WITH ENEL. IN GENERAL, THE INSTITUTE WORKS MOSTLY ON THE BASIC SCIENTIFIC ASPECTS OF GEOTHERMAL ENERGY WHEREAS ENEL CONCENTRATES ON PRACTICAL OR APPLIED ASPECTS. THE INSTITUTE ALSO PROVIDES TECHNICAL ADVICE TO UNDERDEVELOPED COUNTRIES THAT WISH TO DEVELOP THEIR GEOTHERMAL RESOURCES. EACH YEAR THE INSTITUTE GIVES A NINE MONTH COURSE IN GEOTHERMAL RESOURCES RESEARCH FOLLOWED BY TWO MONTHS OF PRACTICAL EXPERIENCE WORKING WITH ITALIAN SCIENTISTS AND TECHNICIANS. ELENA LUBIMOVA OF USSR AND BOLDISZAR OF HUNGARY HAVE RECENTLY TAUGHT MONTH LONG SESSIONS. THERE ARE USUALLY ABOUT A DOZEN PARTICIPANTS AND ALL COURSES ARE TAUGHT IN ENGLISH. THE ITALIAN FOREIGN AFFAIRS MINISTRY PROVIDES SOME SCHOLARSHIPS.

5. THE RESEARCH UNIT OF
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11. THE CONDENSERS ARE COOLED BY INJECTING WATER THROUGH SPRAY NOZZLES DIRECTLY INTO THE STEAM EXHAUSTING FROM THE TURBINES. THE RESULTING WARM WATER IS PUMPED INTO THE BOTTOM OF LARGE HYPERBOLIC NATURAL DRAFT COOLING TOWERS WHERE IT FLOWS DOWN OVER WOOD LATTICE WORK. AMBIENT AIR PASSES UP THROUGH THE LATTICE WORK EVAPORATING PART OF THE WATER AND RISES UP
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THE TOWER BY "NATURAL-DRAFT" ACTION. THE COOLED WATER IS RETURNED TO THE CONDENSERS. THE EFFECT OF THIS DIRECT CYCLE IS TO ACCUMULATE EXCESS WATER IN THE SYSTEM, SINCE ONLY 75 PERCENT OF THE INLET STEAM IS VAPORIZED IN THE COOLING TOWER. THE 25 PERCENT STEAM IS PURGED BY DISCHARGE FROM THE COOLING TOWER DIRECTLY TO A SMALL STREAM FLOWING THROUGH THE PLANT AREA.

12. THIS STEAM IS THE SOURCE OF CONSIDERABLE POLLUTION TO THE AREA. IT CONTAINS THE BULK OF THE ENTRAINED AND VOLATILE IMPURITIES IN THE STEAM LEAVING THE WELL, INCLUDING CLAYS AND DISSOLVED BORATE, SULFIDE AND SULFATE. THE DISCHARGE IS PROBABLY MODERATELY ACIDIC. WE INSPECTED THE DISCHARGE POINT AND NOTED A SIGNIFICANT DECREASE IN VEGETATION BELOW COMPARED WITH ABOVE THE POINT. METAL EQUIPMENT NEAR THE DISCHARGE WAS BADLY CORRODED, AND THE SULFIDE SMELL WAS STRONG.

13. THE PREFERRED SOLUTION TO THE LIQUID WASTE DISCHARGE PROBLEM IS REINJECTION OF THE ENTIRE STEAM INTO THE FORMATION. THIS PAST JANUARY, ENEL BEGAN REINJECTION AT LARDERELLO, USING A NON-PRODUCING 500 METER WELL. THIS DEPTH IS BELOW THE SO-CALLED IMPERMEABLE LAYER WHICH CAPE THE PRESENT STEAM RESERVOIR. THE REINJECTION RATE WAS UP TO 50 TONS PER HOUR. THE PROCESS WAS CARRIED OUT SUCCESSFULLY FOR SEVERAL MONTHS UNTIL IT WAS HALTED BY A COURT ORDER OR INJECTION WHICH WAS OBTAINED BY THE MUNICIPALITY OF CASTELNUOVO SUPPORTED

BY THE PROVINCE OF PISA.

14. THERE WAS NO RPT NO TECHNICAL DOCUMENTATION THAT SHOWED THAT THE REINJECTION WAS HARMFUL TO DRINKING WATER OR THE QUALITY OF WATER IN FLOWING STREAMS. INSTEAD THE BURDEN OF PROOF IS ON ENEL TO SHOW THAT THE REINJECTION PROCESS IS SAFE. IN ONE INTERPRETATION OF THE COURT ORDER ALL CONTAMINATED DISCHARGES INCLUDING THE PRESENT DIRECT FLOW INTO THE STREAM WOULD BE PROHIBITED. ENEL DETERMINED THAT IT WAS COMPLETELY IMPRACTICAL TO USE ION EXCHANGE AND MANAGED TO AVOID HAVING TO SHUT DOWN THE GEOTHERMAL POWER PLANTS PENDING APPEAL OF THE COURT INJUNCTION.

15. THERE WAS A SUGGESTION OR IMPLICATION THAT THE PRESENT
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SITUATION IS NOT ALTOGETHER DISPLEASING TO ENEL. THE OVERFLOW METHOD CONTINUES AND THE MOST PRACTICAL SOLUTION TO PROBLEMS IT CREATES IS TEMPORARILY PROHIBITED. NEVERTHELESS, AN EXPERIMENT IS PLANNED FOR SEPTEMBER, 1973 AT VITERBO WHICH WILL BE PERFORMED TO PROVIDE DATA WITH WHICH TO PROVE THE SAFETY OF THE REINJECTION PROCESS. THERE, TWO WELLS EXIST (SEPARATED BY 4 KILOMETERS) AT A DEPTH OF 200 METERS AND CONTAINING 70/O C WATER. THE WELL NAMES ARE VICO #1 AND VICO #2. BEFORE THE REINJECTION EXPERIMENT BEGINS, THE BACKGROUND SEISMICITY WILL BE MEASURED. LATER SEISMIC MEASUREMENT WILL BE MADE DURING REINJECTION TO DETERMINE IF REINJECTION CAUSES MICRO EARTHQUAKES. THE GEOPHYSICS INSTITUTE OF MILAN IS RESPONSIBLE FOR THE MICROSEISMICITY UNDER CONTRACT FROM ENEL.

16. THE US TEAM MENTIONED SIMILAR EXPERIMENTS IN THE IMPERIAL VALLEY WHICH WILL BE PERFORMED BEFORE DECEMBER, AND THERECNA GREEMENT TO EXCHANGE INFORMATION ON THESE EXPERIMENTS AND REINJECTION TECHNOLOGY IN GENERAL. THE US MEMBERS ALSO DISCUSSED USING STABLE ISOTOPES TRACERS TO PROVE THAT REINJECTED WATER DID NOT ENTER DRINKING WATER OR STREAMS. THE ITALIAN GROUP SEEMED QUITE INTERESTED AND REQUESTED INFORMATION ON COMMERCIAL STABLE ISOTOPE SERVICES IN THE US.

17. ONE TURBINE AT LARDERELLO #3 WAS DOWN AND HAD BEEN DISMANTLED FOR ANNUAL MAINTENANCE. THE FIXED BLADES OF THE TURBINE WERE VISIBLE AND WE NOTED A HEAVY DEPOSIT ON THE HIGH PRESSURE BLADES WHICH SEEMED TO BLOCK THE FLOW. OUR GUIDE REPORTED THAT THIS WAS PRIMARILY CLAY ENTRAINED FROM THE WELLS RATHER THAN SILICA. THE ANNUAL CLEANING WAS SIMPLIFIED BY INJECTING OIL INTO THE STEAM WHICH PROMOTED THE FORMATION OF A FLASKY DEPOSIT.

18. ALTHOUGH THE COMMERCIAL PRODUCTION OF BORON FROM LARDERELLO STEAM HAS ENDED, BORIC ACID IS STILL PRODUCED IN THE AREA FROM CALCIUM BORATE ORE IMPORTED FROM TURKEY. THE WASTE

FROM THIS PLANT IS DISCHARGED INTO THE SAME STREAM AND IS ANOTHER SERIOUS SOURCE OF POLLUTION, PARTICULARLY ARSENIC.

19. THE STEAM FOR THE POWER PLANTS IS COLLECTED FROM WIDELY SEPARATED WELLS AND TRANSMITTED TO THE POWER PLANTS THROUGH ALUMINUM SHEATHED PIPES MOUNTED JUST ABOVE THE SURFACE.

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THESE WEBS OF PIPING HAVE BEEN REFERRED TO AS VISUAL POLLUTION ELSEWHERE BUT SEEM TO BE OF LITTLE CONCERN HERE. ON THE OTHER HAND, THERE IS VERY LITTLE NOISE ASSOCIATED WITH THE ENTIRE LARDERELLO OPERATION.

20. /TRAVALE/ - ONE OF TWO MAJOR NEW DISCOVERIES OF STEAM IN ITALY SINCE THE 1970 PISA GEOTHERMAL SYMPOSIUM IS AT TRAVALE, LOCATED AT THE EASTERN EDGE OF THE GENERAL LARDERELLO GEOTHERMAL AREA. ACTUALLY, IT IS THE SITE OF AN OLD GEOTHERMAL FIELD WHICH HAD BEEN CONSIDERED TO BE EXHAUSTED. IN 1972 ENEL DRILLED A NEW HOLE 750 M DEEP AND INTERSECTED A VERY PERMEABLE ZONE (INTERPRETED TO BE AN OPEN CRACK) FROM WHICH 300 TONS STEAM/HR WAS PRODUCED. THIS IS AN ENORMOUS RATE OF PRODUCTION FROM A SINGLE WELL; THE AVERAGE RATE OF PRODUCTION FROM OTHER WELLS IN THE LARDERELLO REGION IS 20 TO 30 TONS/HR. THE STEAM CONTAINS 5 PERCENT NON-CONDENSIBLE GAS, THE SHUT IN PRESSURE IS 60ATM. AND THE TEMPERATURE AT THE WELL HEAD IS 220/O TO 230/O C. AFTER BRIEF TESTING THE WELL WAS SHUT IN FOR 1 YEAR. ON JULY 7, 1973 IT WAS OPENED AGAIN FOR FURTHER TESTING TO SEE IF THE RATE OF STEAM PRODUCTION WOULD BE SUSTAINED. A SECOND HOLE IS NOW BEING DRILLED. THE FIRST WELL WAS CONNECTED TO A 15 MEGAWATT POWER PLANT OPERATING IN A NON-CONDENSING MODE.

21. /ALFINA/ - THE SECOND MAJOR NEW DISCOVERY OF STEAM IN ITALY IS AT ALFINA, LOCATED ABOUT HALF WAY BETWEEN FLORENCE AND ROME, S.E. OF MONTE AMIATA AND ABOUT 200 KM WEST OF ORDIATO. A WELL 650 M DEEP WAS DRILLED. THE WELL BLEW OUT BECAUSE THEY DID NOT GET ALL OF THE CASING PROPERLY INSTALLED. CARBON DIOXIDE WAS THE PRIMARY OUTPUT, BUT LARGE QUANTITIES OF CLAY PARTICLES WAS PUT INTO THE AIR. SOME ANIMALS WERE MADE SICK, BUT NONE KILLED. THE BLOW-OUT WAS CONTROLLED BY PROPERLY CEMENTING THE CASING INTO PLACE. THE WELL NOW PRODUCES 80 PERCENT GAS (98.5 PERCENT OF GAS IS CO2) BY VOLUME. THE SHUT IN PRESSURE IS 33 ATM. THE HOLE IS NOW BEING VENTED TO THE ATMOSPHERE TO SEE IF THE PROPORTION OF CO2 WILL DECREASE UPON PROLONGED PRODUCTION; AS IS GENERALLY THE CASE AT LARDERELLO AND MONTE AMIATA. THE NON-CONDENSIBLE GAS CONTENT MUST DECREASE TO 20 PERCENT TO PERMIT EXPLOITATION WITH PRESENT TECHNOLOGY. THE ENEL WOULD LIKE TO DEVELOP 50 MEGAWATTS AT ALFINA.

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2. THE ALFINA HOLE WAS DRILLED AT THE CENTER OF AN ANOMALY OUTLINED BY SHALLOW TEMPERATURE GRADIENT MEASUREMENTS. THE MAXIMUM MEASURED GRADIENT WAS 1.5/O C PER 10 METERS.

23. /POWER FROM HOT WATER/ - THE ENEL IS INTERESTED IN BOTH THE TECHNOLOGY AND ECONOMICS OF ELECTRICITY PRODUCTION FROM HOT WATER. PROFESSOR SILVESTRI, A PHYSICIST AT THE MILAN POLYTECHNICAL UNIVERSITY, CONCEIVED IN 1969 OF A POWER SYSTEM EMPLOYING A SO-CALLED GRAVIMETRIC LOOP WITH WHICH HE HAS SINCE BEEN EXPERIMENTING IN SMALL MODELS. A 100 KW PILOT TEST WILL BE PERFORMED SOON AT LARDERELLO USING 100/O C WATER. THE TECHNICAL DETAILS OF HIS SYSTEM WERE UNCLEAR BUT SEEMED TO INVOLVE DIRECT
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